

WHAT IS CLAIMED IS:

- 1 1. A method of extracting data from a data stream, comprising the steps of:
2 oversampling said data stream at an oversampling rate and generating a plurality
3 of data samples;
4 processing said plurality of data samples and generating a plurality of first results,
5 wherein said plurality of data samples is processed such that a set of two or more adjacent data
6 samples is processed together, and wherein a number of elements in said set corresponds to said
7 oversampling rate;
8 processing said plurality of first results over time and generating a plurality of
9 second results, wherein each of said plurality of first results is processed with others of said
10 plurality of first results such that a number of said plurality of second results corresponds to said
11 oversampling rate; and
12 analyzing said plurality of second results and selecting an alignment of said
13 plurality of data samples according to one of said plurality of second results.

- 1 2. The method of claim 1, wherein said oversampling rate is N times an
2 expected rate of said data stream.

- 1 3. The method of claim 2, wherein said set contains N elements.

- 1 4. The method of claim 2, wherein N is said number of said plurality of
2 second results.

- 1 5. The method of claim 1, wherein said plurality of data samples is processed
2 such that similar ones of said set are added and dissimilar ones of said set are subtracted to result
3 in one of said plurality of first results.

- 1 6. The method of claim 1, wherein said plurality of first results is processed
2 such that a first one of said plurality of first results at a first time, and a second one of said
3 plurality of first results at a second time, are added to result in one of said plurality of second
4 results.

1 7. The method of claim 1, wherein said alignment is selected based on a
2 largest-valued one of said plurality of second results.

1 8. The method of claim 1, wherein said alignment is selected based on a
2 smallest-valued one of said plurality of second results.

1 9. An apparatus for extracting data from a data stream, comprising:
2 an oversampler configured to oversample said data stream at an oversampling rate
3 and to generate a plurality of data samples;
4 a first plurality of processing elements, coupled to said oversampler, each
5 configured to process, respectively, a set of two or more adjacent data samples of said plurality
6 of data samples and to generate a plurality of first results, wherein a number of elements in said
7 set corresponds to said oversampling rate;
8 a second plurality of processing elements, coupled to said first plurality of
9 processing elements, configured to process said plurality of first results over time and to generate
10 a plurality of second results, wherein each of said plurality of first results is processed with
11 others of said plurality of first results such that a number of said plurality of second results
12 corresponds to said oversampling rate; and
13 a comparator element, coupled to said oversampler and said second plurality of
14 processing elements, configured to analyze said plurality of second results and to select an
15 alignment of said plurality of data samples according to one of said plurality of second results.

1 10. The apparatus of claim 9, wherein said oversampling rate is N times an
2 expected rate of said data stream.

1 11. The apparatus of claim 10, wherein said first plurality of processing
2 elements contains N processing elements.

1 12. The apparatus of claim 10, wherein said second plurality of processing
2 elements contains N processing elements.

1 13. The apparatus of claim 9, wherein one of said first plurality of processing
2 elements is configured to process said set such that similar ones of said set are added and
3 dissimilar ones of said set are subtracted to result in one of said plurality of first results.

1 14. The apparatus of claim 9, wherein one of said second plurality of
2 processing elements is configured to process said plurality of first results such that a first one of
3 said plurality of first results at a first time, and a second one of said plurality of first results at a
4 second time, are added to result in one of said plurality of second results.

1 15. The apparatus of claim 9, wherein said comparator selects said alignment
2 based on a largest-valued one of said plurality of second results.

1 16. The apparatus of claim 9, wherein said comparator selects said alignment
2 based on a smallest-valued one of said plurality of second results.

1 17. The apparatus of claim 9, wherein said first plurality of processing
2 elements comprises:

3 a plurality of delay elements configured to delay said plurality of data samples
4 and to generate a plurality of delayed data samples; and

5 a plurality of accumulators, coupled to said plurality of delay elements,
6 configured to accumulate selected ones of said plurality of delayed data samples and to generate
7 said plurality of first results.

1 18. The apparatus of claim 9, wherein said second plurality of processing
2 elements comprises:

3 a plurality of accumulators configured to accumulate said plurality of first results
4 over time and to generate said plurality of second results; and

5 an overflow control circuit, coupled to said plurality of accumulators, configured
6 to prevent said plurality of accumulators from overflowing.

1 19. A method of extracting data from a data stream, comprising the steps of:
2 oversampling said data stream at an oversampling rate and generating a plurality
3 of data samples;

4 processing said plurality of data samples and generating a plurality of first results,
5 wherein said plurality of data samples is processed such that a set of two or more nearby data
6 samples is processed together, wherein a number of elements in said set corresponds to said
7 oversampling rate, and wherein said set is processed according to a mirror axis of said set;

8 processing said plurality of first results over time and generating a plurality of
9 second results, wherein each of said plurality of first results is processed with others of said
10 plurality of first results such that a number of said plurality of second results corresponds to said
11 oversampling rate; and

12 analyzing said plurality of second results and selecting an alignment of said
13 plurality of data samples according to one of said plurality of second results.

1 20. An apparatus for extracting data from a data stream, comprising:
2 an oversampler configured to oversample said data stream at an oversampling rate
3 and to generate a plurality of data samples;

4 a first plurality of processing elements, coupled to said oversampler, each
5 configured to process, respectively, a set of two or more nearby data samples of said plurality of
6 data samples and to generate a plurality of first results, wherein a number of elements in said set
7 corresponds to said oversampling rate, and wherein said set is processed according to a mirror
8 axis of said set;

9 a second plurality of processing elements, coupled to said first plurality of
10 processing elements, configured to process said plurality of first results over time and to generate
11 a plurality of second results, wherein each of said plurality of first results is processed with
12 others of said plurality of first results such that a number of said plurality of second results
13 corresponds to said oversampling rate; and

14 a comparator element, coupled to said oversampler and said second plurality of
15 processing elements, configured to analyze said plurality of second results and to select an
16 alignment of said plurality of data samples according to one of said plurality of second results.

1 21. The apparatus of claim 20, wherein said first plurality of processing
2 elements comprises:

3 a plurality of delay elements configured to delay said plurality of data samples
4 and to generate a plurality of delayed data samples; and

5 a plurality of XOR blocks, coupled to said plurality of delay elements, configured
6 to perform an XOR operation on selected ones of said plurality of delayed data samples and to
7 generate said plurality of first results.

1 22. The apparatus of claim 20, wherein said first plurality of processing
2 elements comprises:

3 a plurality of delay elements configured to delay said plurality of data samples
4 and to generate a plurality of delayed data samples;

5 a plurality of XOR blocks, coupled to said plurality of delay elements, configured
6 to perform an XOR operation on selected ones of said plurality of delayed data samples and to
7 generate a plurality of intermediate results; and

8 a plurality of accumulators, coupled to said plurality of XOR blocks, configured
9 to accumulate selected ones of said plurality of intermediate results and to generate said plurality
10 of first results.

1 23. The apparatus of claim 20, wherein said second plurality of processing
2 elements comprises:

3 a plurality of accumulators configured to accumulate said plurality of first results
4 over time and to generate said plurality of second results; and

5 an overflow control circuit, coupled to said plurality of accumulators, configured
6 to prevent said plurality of accumulators from overflowing.

1 24. A programmable logic device, comprising:

2 a plurality of function blocks, each configured to perform a respective function;
3 an interconnect configured to programmably connect said plurality of function
4 blocks; and

5 a data extractor, coupled to said plurality of function blocks via said interconnect,
6 for extracting data from a data stream, including:

7 an oversampler configured to oversample said data stream at an
8 oversampling rate and to generate a plurality of data samples;

9 a first plurality of processing elements, coupled to said oversampler, each
10 configured to process, respectively, a set of two or more adjacent data samples of said plurality

11 of data samples and to generate a plurality of first results, wherein a number of elements in said
12 set corresponds to said oversampling rate;
13 a second plurality of processing elements, coupled to said first plurality of
14 processing elements, configured to process said plurality of first results over time and to generate
15 a plurality of second results, wherein each of said plurality of first results is processed with
16 others of said plurality of first results such that a number of said plurality of second results
17 corresponds to said oversampling rate; and
18 a comparator element, coupled to said oversampler and said second
19 plurality of processing elements, configured to analyze said plurality of second results and to
20 select an alignment of said plurality of data samples according to one of said plurality of second
21 results.

1 25. . A programmable logic device, comprising:
2 a plurality of function blocks, each configured to perform a respective function;
3 an interconnect configured to programmably connect said plurality of function
4 blocks; and
5 a data extractor, coupled to said plurality of function blocks via said interconnect,
6 for extracting data from a data stream, including:
7 an oversampler configured to oversample said data stream at an
8 oversampling rate and to generate a plurality of data samples;
9 a first plurality of processing elements, coupled to said oversampler, each
10 configured to process, respectively, a set of two or more nearby data samples of said plurality of
11 data samples and to generate a plurality of first results, wherein a number of elements in said set
12 corresponds to said oversampling rate, and wherein said set is processed according to a mirror
13 axis of said set;
14 a second plurality of processing elements, coupled to said first plurality of
15 processing elements, configured to process said plurality of first results over time and to generate
16 a plurality of second results, wherein each of said plurality of first results is processed with
17 others of said plurality of first results such that a number of said plurality of second results
18 corresponds to said oversampling rate; and
19 a comparator element, coupled to said oversampler and said second
20 plurality of processing elements, configured to analyze said plurality of second results and to

21 select an alignment of said plurality of data samples according to one of said plurality of second
22 results.